Dothistroma Needle Blight of Pines

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Dothistroma needle blight, caused by the fungus *Dothistroma pini*, is the most damaging disease of pines in the Southern Hemisphere (East Africa, New Zealand, Chile). Severe damage has been caused by this disease in North America too, especially in plantings. Losses in Christmas tree plantings can be especially severe, since the trees can be rendered unmarketable by this disease in a single season.

The disease seldom has been detected in young seedlings in North American nurseries, yet experience with epidemics in isolated new plantings in the Great Plains indicates that trees infected in the nursery must have been responsible. The fungus commonly has been found on older pine transplants in nurseries in the Central States which produce pines for landscape plantings.

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Distribution and Hosts

Dothistroma needle blight has caused much devastation in the past decade in pine plantations (chiefly Monterey pine) in the Southern Hemisphere. The fungus has been found on pines in England, France, Yugoslavia, Rumania, Russia (Georgia), India, East Africa, South Africa, New Zealand, and South America (Argentina, Brazil, Chile, Uruguay). Over 30 pine species, including 2- , 3- , and 5-needle pines, are susceptible to this needle blight. Douglas-fir in Chile and California, Sitka spruce in California, and European larch in New Zealand also have been reported as hosts.

Twenty pine species and hybrids are known hosts in North America; the fungus has been found in 23 of the United States and four Provinces of Canada, but has not been reported in Mexico.

Dothistroma pini was first recognized in the 1940's in several localities in eastern and central

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United States, where it is found most frequently on planted Austrian and ponderosa pines. These two tree species are highly susceptible. The fungus has not been reported in natural pine stands in eastern and central United States.

Damage in the Eastern States and Canada has been light. In the Central States, young plantations of Austrian and ponderosa pines have been severely damaged and sometimes destroyed.

The presence of Dothistroma needle blight in western United States and Canada was confirmed in the 1960's. The fungus is now widespread in plantations and natural stands of lodgepole, ponderosa, and western white pines in British Columbia. Damage in plantations and natural stands of lodgepole and ponderosa pines in Washington, Oregon, Montana, and Idaho has varied from light to heavy. The disease has killed Monterey pine in plantations on the West Coast (California, Oregon, British Columbia), but has not been reported in natural stands of this tree species.

Dothistroma needle blight can be confused with brown spot disease caused by the fungus *Scirrhia acicola,* since the symptoms are similar. However, symptoms of brown spot appear much earlier (July) in the central United States than do symptoms of Dothistroma blight (September, October). The conidial state of the two causal fungi are similar, but conidia of the brown spot fungus are wider, darker colored, and sickle shaped. These two fungi also have several hosts in common. Scots pine, however, which is severely damaged by the brown spot fungus, is rarely infected and seldom damaged seriously by *Dothistroma pini.* A plantation of 36 geographic sources of Scots pine in eastern Nebraska has remained free of the disease, but an adjacent plantation of Austrian pine has been severely damaged.

Evidence of Infection

Symptoms develop in the fall of the year of infection in the central United States and British Columbia. Early symptoms on the needles consist of yellow and tan spots and bands that appear water soaked. The spots and bands may turn brown to reddish brown. The reddish bands are more distinctive and numerous on infected needles of pines in the western United States where this disease is often referred to as red band disease. Commonly, the distal ends of infected needles become chlorotic, then necrotic, with the base of the needles remaining green. Needles may develop extensive necrosis 2 to 3 weeks after the first appearance of symptoms.

Infected needles drop prematurely. Infected second-year needles are cast before infected first-year (current-year) needles. In some seasons, second-year needles are cast in late fall of the year they became infected. In other seasons, loss of needles is not extensive until late the following spring or early summer. Needles that become infected the year they emerge often are not

shed until late summer the following year.

Life Cycle

The fungus has both a sexual stage (*Scirrhia pini*) and an asexual stage (*Dothistroma pini*). The sexual stage has been found in British Columbia, Alaska, Oregon, and California but not elsewhere in North America. Ascospores are produced by the sexual stage; their role in development of epidemics is not known. Much is known, however, about the role of conidia in disease development. Conidia (spores produced by the asexual stage) are cylindrical, curved, 1- to 5- but usually 3-septate, and hyaline (fig. 1*A*). The conidia vary in length from 16 to 64 μm and in width from 2.4 to 3.5 μm. Conidia from western North America are considerably longer on the average than those found elsewhere on the continent. These differences in length of conidia have led to a designation of varieties of the fungus; *linearis,* the longest-spored form, is found in western North America; *pini,* the shortest-spored form, is found in central and eastern United States; and *keniensis,* with conidia intermediate in length, is found in East Africa.

Conidia are borne in stromata (fruiting bodies) which develop below the epidermis of needles (fig. 1*B*). Stromata may develop sufficiently in the fall in the central United States to raise and split the epidermis. They generally do not mature and produce conidia until the following spring, however. The conidia are exposed as the epidermis is raised (fig. 1*C*). They are released during wet weather and dispersed by rainsplash any time during the growing season. Thus, new infections can occur any time from May to October when it rains. Symptoms do not appear on newly infected needles until early fall in the central United States, however.

Two growing seasons are required for completion of the life cycle in most areas of North America, although in California and along the British Columbia coast the cycle may be completed in 1 year.

Control Measures

Copper fungicides effectively prevent infection by Dothistroma needle blight. Bordeaux mixture (8 pounds of copper sulfate, 8 pounds of hydrated lime, 100 gallons of water) applied twice in the growing season has provided essentially complete control in shelterbelt, Christmas tree, and other plantings in the central United States. The first application (mid-May) protects previous seasons' needles; the second application protects current-year needles. When controlling this disease in plantings of Austrian or ponderosa pines, the second application can be made after considerable new growth has occurred, since current-year needles of these species are initially resistant to infection and do not become susceptible until midsummer (July).

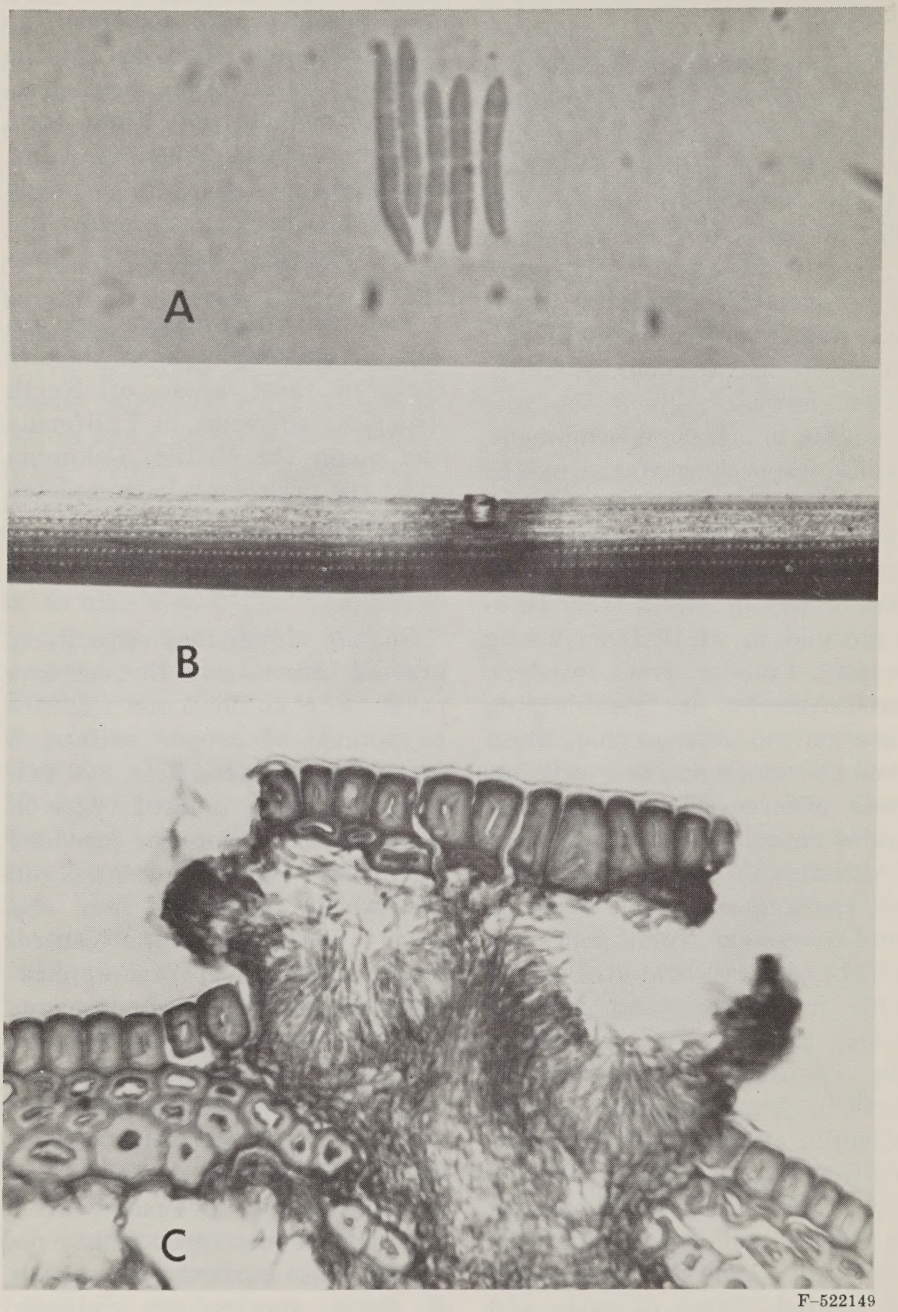

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Figure 1.—*Dothistroma pini* obtained from needles of Austrian pine in Nebraska: *A*, Conidia (spores); *B*, Fruiting body or stroma raising the epidermis of a needle; *C*, Cross section through a fruiting body (note the cylindrical, slightly curved conidia that have developed in the cavity at upper left).

Effective control has also been obtained in plantings in the Midwest with a single application made after considerable growth has occurred (early June). There is some risk in this procedure, since infection could occur prior to the early June application. A single application will control this disease on trees which do not have susceptible first-year needles.

Procedures for control of the disease in the West will differ from those that are effective in the Midwest because of differences in the life cycle of the fungus, hosts, growth, and weather. To develop sound recommendations for chemical control of Dothistroma blight in the Western United States, additional biological information is needed.

The use of genetic resistance looks promising for preventing or reducing damage by this fungus. Resistant strains or clones have been reported in Austrian, ponderosa, and Monterey pines. The pattern of resistance varies considerably in Austrian and ponderosa pines. On some trees, needles of all ages are highly resistant. On other trees, current-year needles are resistant but older needles are susceptible.

Warning: Recommendations for use of fungicides are reviewed regularly. The registrations on all suggested uses of fungicides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural experiment station, or local forester to determine if these recommendations are still current.

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